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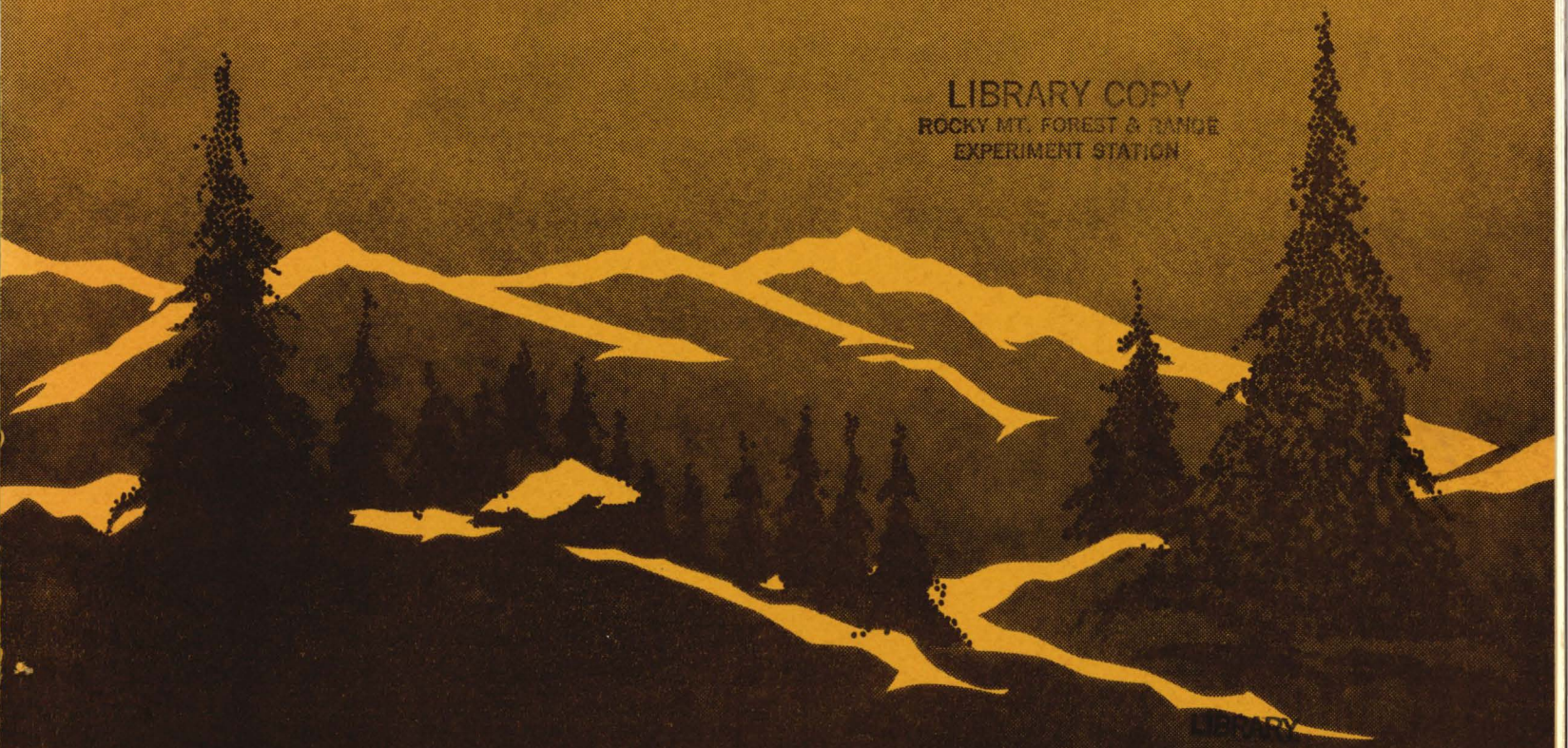
FOREST PEST MANAGEMENT

3430 BIOLOGICAL EVALUATION
R2-82-1

MOUNTAIN PINE BEETLE EVALUATION
STATE, COUNTY, AND PRIVATE LANDS
CASPER MOUNTAIN, WYOMING
1981



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Forest Service

Forest Pest Management
Denver, Colorado

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MOUNTAIN PINE BEETLE EVALUATION
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INTRODUCTION

Scattered groups of mountain pine beetle infested lodgepole pine and ponderosa pine were detected during aerial reconnaissance surveys in July 1979 on Casper Mountain. In 1980 and 1981 infested tree groups expanded in size on about a 1:1 ratio (from aerial reconnaissance observations) (Figure 1). Ground surveys in 1981 indicate a substantial beetle population increase in previously uninfested lodgepole pine stands.

The purpose of this evaluation is to provide future projections of mountain pine beetle infestation levels in relation to lodgepole pine and ponderosa pine susceptibility to mountain pine beetle attack in the Casper Mountain area.

METHODS

Variable plots (20 BAF) were established on 5x5 chain grids in stands of lodgepole pine and ponderosa pine. The following parameters were measured at each plot:

1. Diameter (d.b.h.) of ponderosa pine and lodgepole pine by infestation class:

    a. Uninfested
    b. 1981-infested
    c. 1980-infested
    d. Snag (infested prior to 1980)

2. Diameter (d.b.h.) of other tree species on the plot

3. Age of lodgepole pine and ponderosa pine

Separate risk rating procedures were used for lodgepole pine stands (Amman et al 1977) and ponderosa pine stands (Stevens et al 1980).

Lodgepole Pine - Three parameters are used to determine stand susceptibility to the mountain pine beetle:

1. Elevation - latitude

2. Average stand age (years)

3. Average stand diameter (d.b.h. inches)

For each parameter a risk factor is assigned to the stand. By multiplying the risk factors for each parameter, the stand's susceptibility classification is obtained: Low = 1 to 9; moderate = 12 to 18; high = 27.

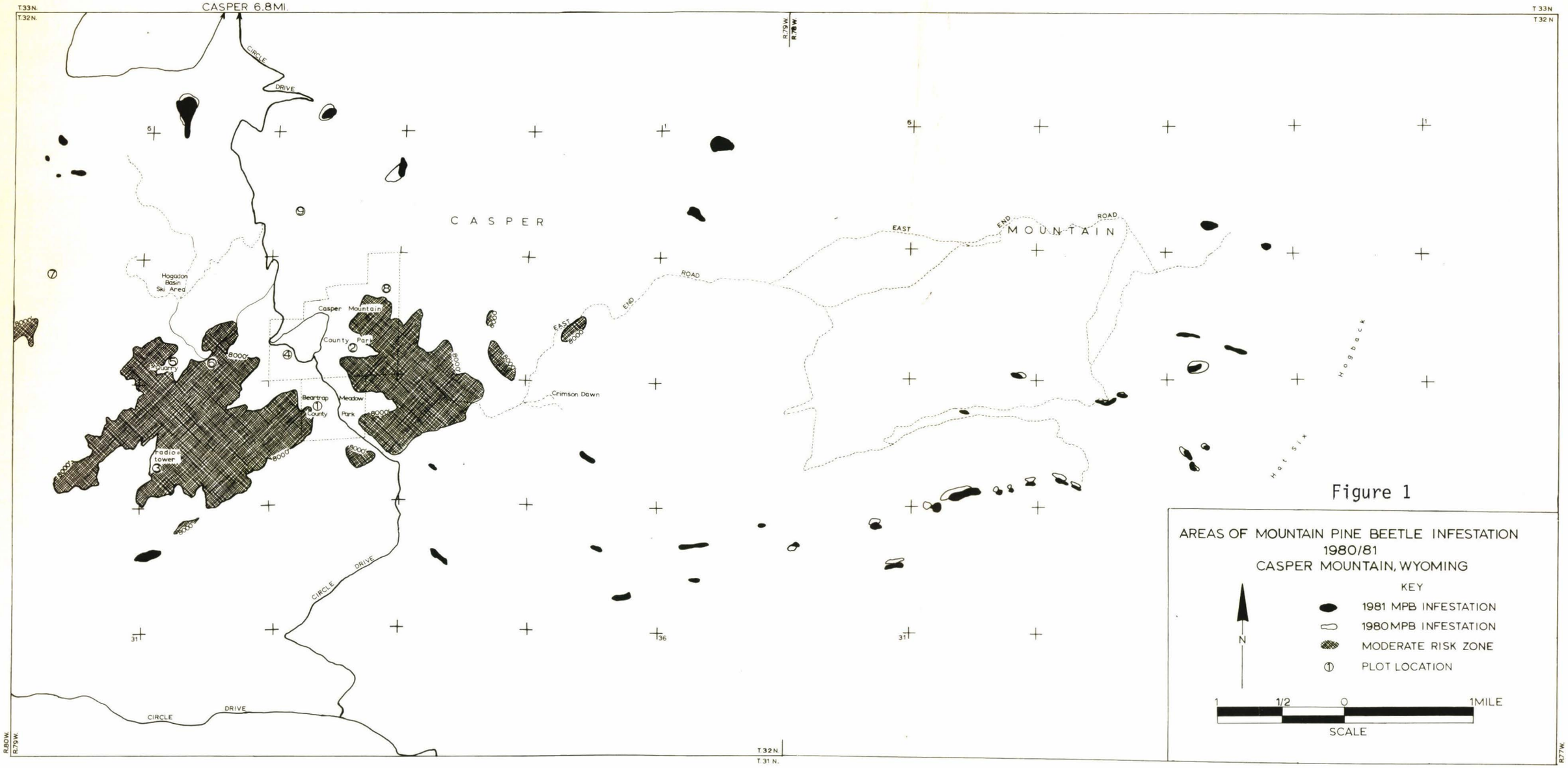
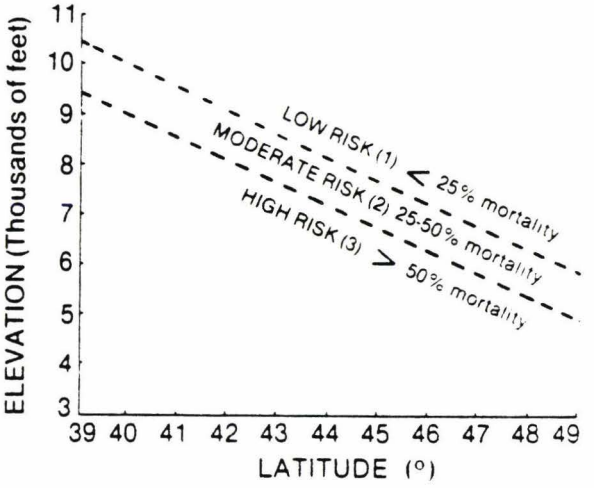

T.33N.
T.32N.
CASPER 6.8MI.
R.79W.
R.78W.
T.33N
T.32N
CIRCLE
DRIVE
CASPER
MOUNTAIN
EAST
END
ROAD
Hogadon
Basin
Ski Area
Casper Mountain
County Park
Beartrap
County
Meadow
Park
Crimson Dawn
Hogback
Hat Six
radio
tower
8000
CIRCLE DRIVE
CIRCLE DRIVE
R.80W.
R.79W.
T.32N.
T.31N.
R.77W.
AREAS OF MOUNTAIN PINE BEETLE INFESTATION
1980/81
CASPER MOUNTAIN, WYOMING
KEY
1981 MPB INFESTATION
1980 MPB INFESTATION
MODERATE RISK ZONE
PLOT LOCATION
N
1
1/2
0
1 MILE
SCALE

Figure 1

The latitude for Casper Mountain ranges from 42° 42' to 42° 45' or about 42.75°. Elevations range from about 7000 feet to just above 8000 feet. At a latitude of 42.75° all stands less than 8000 feet in elevation are assigned a risk factor of 3; and, stands greater than 8000 feet are assigned a risk factor of 2 (Figure 2). Since the elevational zone does not extend to 8700 feet, a low risk for this parameter cannot be assigned to stands on Casper Mountain.

Figure 2 -- Risk of mountain pine beetle infestation in lodgepole pine can be defined by zones of elevation and latitude. Percent mortality is for trees 8.5 inches d.b.h. and larger.



Risk factors for average stand age (years) and diameter (inches) are tabulated below:

TABLE 1 -- Risk Factors for Age and Diameter in Lodgepole Pine

Average Age (Years)	Risk Factor	Average d.b.h. (Inches)	Risk Factor
<60	(1)	<7	(1)
60-80	(2)	7-8	(2)
>80	(3)	>8	(3)

Stands given an overall susceptibility classification of low can be expected to sustain lodgepole pine tree losses of less than 25% for trees in excess of 8.5 inches diameter; moderate 25-50%; and, high greater than 50%.

Ponderosa Pine - Three parameters are used to determine stand susceptibility to mountain pine beetle:

1. Stand structure
2. Average stand diameter (d.b.h. inches)
3. Average stand density (sq.ft. per acre)

As in the guidelines for lodgepole pine, risk factors are assigned to each parameter. The risk factors are multiplied together to produce the following susceptibility classification: low = 2 to 6; moderate = 8 to 12; high = 18 to 27. The three parameters and corresponding risk factors are tabulated below:

TABLE 2 -- MPB Risk Classes for Black Hills Ponderosa Pine

	Risk Classes		
	1 = low	2 = moderate	3 = high
Stand structure	-	2-storied	single-storied
Average stand d.b.h. (inches)	<6	6-10	>10
Stand density (square feet per acre)	>80	80-150	>150

RESULTS

Table 3 provides a summary of stand information for Casper Mountain in 1981. On the survey plots, seven 1981-infested trees were tallied and no 1980-infested trees were tallied. This indicates a significant uptrend in the infestation.

Using the risk rating procedures (Amman et al 1977) for lodgepole pine, the risk of infestation on Casper Mountain ranges from low to high. The single ponderosa pine stand survey has a moderate risk. Risk parameters and consequent risk by stand are provided in Table 4.

Figures 3 and 4 show the distribution of lodgepole pine and ponderosa pine diameters on Casper Mountain. The implications to management strategies of these distributions will be covered in the discussion section.

DISCUSSION

Lodgepole pine stands - Of the three parameters used to determine stand susceptibility only average stand age and average stand diameter can be changed through cutting strategies to reduce the level of susceptibility.

In the past, even aged stands of lodgepole pine have been created by fire. Based on stand age classes on Casper Mountain, two catastrophic fires, covering most of the mountain occurred. The first fire occurred about 1810-1830 and the second about 1875-1895. Because of the excess timber on the mountain a third fire could occur in the near future. Lack of access for fire fighters as well as a high probability of an intense and sustained crown fire would seriously hinder fire suppression efforts.

TABLE 3 -- Summary of Stand Information for Casper Mountain, Wyoming, 1981

Stand Number	Average Lodgepole Pine Diameters (in.) by Infestation Class				Average Ponderosa Pine Diameter (in.) by Infestation Class				Average Diameter (in.) Other Tree Species	
	Uninfested ± S.E.	1981 Infested ± S.E.	1980 Infested ± S.E.	Snag ± S.E.	Uninfested ± S.E.	1981 Infested ± S.E.	1980 Infested ± S.E.	Snag ± S.E.	Aspen ± S.E.	Fir ± S.E
1	12.5 ± .5	14.4 ± 1.1		10.8[a]					7.0 ± .6	10.3 ± 2.4
2	11.0 ± .6	13.7 ± 1.8							6.0 ± .7	7.8 ± 4.7
3	10.4 ± .4	14.2 ± 1.4		11.6 ± 1.2					8.3 ± 3.8	
4	6.2 ± .2			4.7 ± 1.4[b]					5.9 ± 1.1	4.0 [a]
5	9.6 ± .3			3.2 [a][b]					5.8 ± .4	
6	7.4 ± .3			4.7 ± .9[b]					8.9 [a]	
7	12.0 ± .6								6.6 ± .4	
8	12.9 ± .5			9.4 [a]						9.2 ± .6
9					11.4 ± .8			5.6 [a]		
	9.5 ± .2	14.1 ± .7		6.7± .9					6.6 ± .3	9.1 ± .6

[a] Only one observation

[b] Trees killed due to competition for growing space

FIGURE 3.

DIAMETER DISTRIBUTION OF LODGEPOLE PINE (3IN. SIZE CLASS) CASPER MOUNTAIN, WYOMING–1981

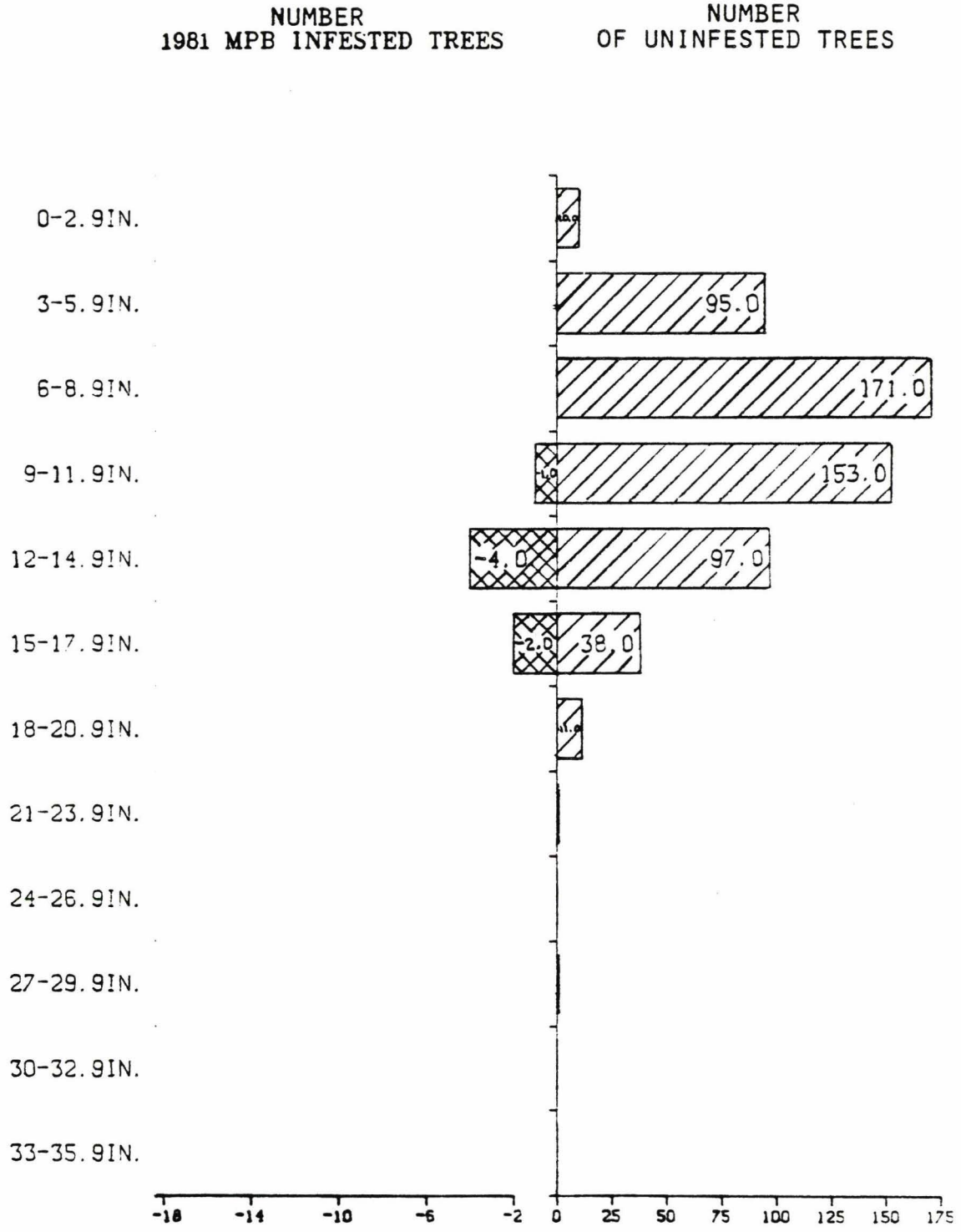
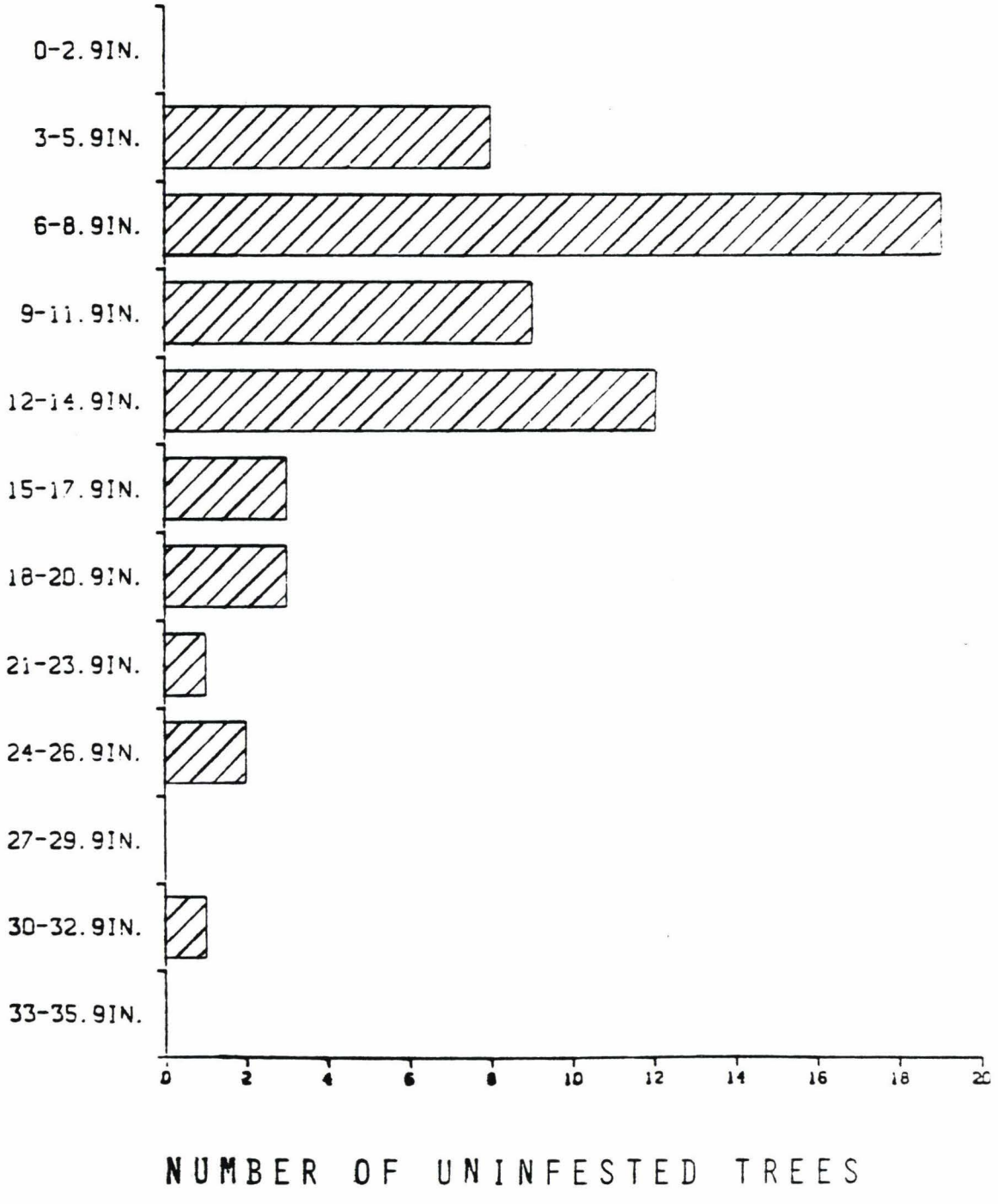


FIGURE 4.

DIAMETER DISTRIBUTION OF PONDEROSA PINE (3IN. SIZE CLASS) CASPER MOUNTAIN, WYOMING–1981



Since the average stand age on the mountain exceeds 80 years, all stands receive a high risk based on this parameter (Table 3). To reduce the risk, the average stand age should be reduced. Since few trees are less than 80 years old, the strategies available for reducing risk due to age are limited at this time.

Over time, management strategies can change average stand age. These strategies include:

1. Clearcut and plant
2. Clearcut and encourage natural regeneration
3. Shelterwood cut and encourage natural regeneration
4. Burn and encourage natural regeneration

Although the stands on Casper Mountain are generally even aged (about 95 years old), average stand diameters vary significantly. The range of diameters sampled in this survey was 6.2 $\pm$ .2 to 12.9 $\pm$ .5 inches. Referring to Table 1, low risk stands have an average diameter of less than 7.0 inches; moderate risk stands 7.0 - 8.0 inches; and, high risk stands greater than 8.0 inches.

TABLE 4 -- Risk Parameters and Risk Rating for Selected Ponderosa Pine and Lodgepole Pine Stands, Casper Mountain, Wyoming

Stand	Tree Species	Average Diameter (in)	Average Age (yrs)	Average BA [a] (sq.ft/ac)	Stand Structure	Elevation[b] (ft)	Risk
1	Lodgepole	12.5 $\pm$ .5	>80			7900	High
2	Lodgepole	11.0 $\pm$ .6	>80			7900	High
3	Lodgepole	10.4 $\pm$ .4	>80			8100	Mod
4	Lodgepole	6.2 $\pm$ .2	>80			7900	Low
5	Lodgepole	9.6 $\pm$ .3	>80			8000	Mod
6	Lodgepole	7.4 $\pm$ .3	>80			8000	Mod
7	Lodgepole	12.0 $\pm$ .6	>80			7800	High
8	Lodgepole	12.9 $\pm$ .5	>80			7900	High
9	Ponderosa	11.4 $\pm$ .8		116	2-story		Mod

a/ BA = Basal Area

b/ Latitude = 42.75°

Referring to Figure 3, lodgepole pine trees currently being attacked by mountain pine beetle range in diameter from 10.0 - 17.9 inches. As infestation intensity increases, both larger and smaller trees should be attacked in increasing proportions. Of greatest risk are those trees greater than 8.0 inches diameter. Trees in this diameter range constitute about 65% of all trees on the mountain. The strategies available for reducing average stand diameter are:

1. Clearcut and plant
2. Clearcut and encourage natural regeneration
3. Thinning from above (removing larger overstory trees)
4. Burn and encourage natural regeneration

Alternatives

1. Do nothing: This alternative is the no management alternative. It is predicted that mountain pine beetle will continue to cause loss of a large percentage of trees larger than 7.0 inches diameter. It is also predicted that the potential for fire will increase due to increased fuel (beetle-killed trees) and maintenance of a continuous forest canopy.

2. Clearcut or group selection and encourage natural regeneration: Since lodgepole pine, in most cases, requires a fire to open seed cones, the probability of natural regeneration is small. Natural regeneration from fir, if a seed source is available, would not only produce forest cover but also reduce the future risk to mountain pine beetle. Two prominent problems with fir on Casper Mountain are fir broom rust and root rot. The impact of these pathogens can be minimized by maintaining young, vigorous stands. Another possibility would be to clearcut mixed aspen lodgepole pine stands to stimulate aspen regeneration. This is accomplished by removing all lodgepole pine and aspen to stimulate aspen sprouting.

3. Clearcut or group selection and plant: This alternative is identical to alternative 2 except the clearcut area is planted with native trees and/or shrubs. Shrub plantings could be used to improve wildlife habitat while a new forest is being regenerated.

Note: Both clearcut alternatives involve removing all trees from a designated portion of the property being managed. Clearcutting the entire property is not recommended. Clearcut patches (group selection) could be as small as 150 feet in diameter and as large as an acre. The purpose in clearcutting is to establish a series of small even aged stands with each patch containing a different age class. Consider making one to four small clearcut patches every five years.

4. Shelterwood cut and encourage natural regeneration: This alternative involves removal of a percentage of the trees leaving only the larger, disease-free trees to supply a natural seed source. The problems inherent in lodgepole pine regeneration in alternative 2 apply

here. If too many trees are removed, the possibility of windthrow could cause an additional problem. Windthrow can be minimized by removing a small percentage of trees each year until the desired results have been achieved. The residual seed trees pose the same risk to mountain pine beetle as before management except that some increase in individual tree vigor should reduce susceptibility by a slight degree.

5. Thinning from above: This alternative is really the reverse procedure outlined in alternative 4. The exception is that natural regeneration would not be expected to develop until the residual stand matures and produces a cone crop. It involves removing all of the large overstory trees. This alternative could be applied over the entire property in one year with little risk to windthrow if relatively few (20% or less) of the trees on the property are large, overstory trees. This alternative could substantially reduce the susceptibility to mountain pine beetle by reducing average stand diameter.

6. Thinning small diameter stands (less than 7.0 inches): This alternative would be applied where there are no distinct overstory trees and little or no dwarf mistletoe. It involves removing a percentage of the trees on the property to increase the vigor of the residual trees. This alternative would also be applied to young stands created by applying alternatives 1-4 and as residual stands in alternative 5 increase in diameter. Growth response to thinning will increase susceptibility to mountain pine beetle over time.

7. Apply combinations of alternatives 1-6 to increase diversity of the forest type, lodgepole pine age and diameter classes.

Ponderosa pine -- There is no suitable risk rating system for ponderosa pine stands on Casper Mountain. The risk rating system in the Black Hills was used to obtain the moderate risk rating in Table 4. Ponderosa pine stands with a diversity of size and age classes will sustain less losses than even aged, uniform diameter stands. The diameter distribution in Figure 4 shows good diversity in size classes. Age measurements indicate two dominant age classes 80 years old and 170 years old.

Alternatives

1. Do nothing: Same as alternative 1 for lodgepole pine.

2. Harvest overmature trees (large diameter trees greater than 25.0 inches): This involves removing large diameter trees and planting ponderosa pine seedlings. Plantings should be done over time to increase size and age diversity. As the new plantings grow into large diameter classes, additional overmature trees should be harvested (18.0 - 20.0 inches).

3. Shelterwood cut and encourage natural regeneration: This alternative involves removal of a percentage of the trees leaving only the larger trees to provide a seed source. Risk of windthrow in ponderosa

pine is substantially less than that of lodgepole pine. Since fire is not required to open cones, natural ponderosa pine regeneration should be more substantial than lodgepole pine.

4. Thinning small diameter stands: This alternative is the same as alternative 6 for lodgepole pine.

SUMMARY

Overall stand susceptibility to mountain pine beetle on Casper Mountain is moderate to high. The risk of catastrophic fire occurring in the near future is increasing due to poor access to the mountain, accumulations of MPB-killed trees, and a dense crown structure, particularly in the lodgepole pine type. Mountain pine beetle infestations are expected to increase substantially over the next three to five years with possible losses of 65% of the lodgepole pine trees. These dead trees will increase the fire potential substantially.

Management of the forest type could reduce the losses to mountain pine beetle as well as reduce the fire potential. Management alternatives have been presented for both the lodgepole pine and ponderosa pine types. In general, encouraging a greater diversity of forest types (favoring aspen and fir on some acreages) and age and size classes (in pine) will substantially reduce susceptibility to mountain pine beetle in the future. In addition, harvesting and thinning will break up the continuity of tree crowns with a consequent reduction in fire potential.

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